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Yosemite National Park Beverage Container Deposit Experiment

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YOSEMITE NATIONAL PARK
BEVERAGE CONTAINER DEPOSIT EXPERIMENT
FINAL REPORT

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Tayler H. Bingham was project manager for this study. Jerome A. Olson was primarily responsible for the development of the statistical estimates. Juanita Daber assisted in writing this report.

Our appreciation is extended to individuals of the Yosemite Park and Curry Co. and of the National Park Service for providing the necessary data and interpretations. In particular, from Curry Co. we would like to cite Edward Hardy, Chief Operating Officer; Garrett DeBell; Art Goertzen, Jr.; John Crofut and William Letts and from National Park Service, Leonard McKenzie and Jerry Andrews. Marion Thompson of EPA was project officer for this study. Her interest and guidance are very much appreciated.

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YOSEMITE NATIONAL PARK DEPOSIT EXPERIMENT

I. Introduction

On May 17, 1976 the Yosemite Park and Curry Co. with the support of the National Park Service and the Environmental Protection Agency voluntarily instituted a 5-cent deposit on all beer and soft drink containers, both retail and vended, sold in Yosemite National Park, California. Prior to the promulgation of Beverage Container Guidelines applicable to Federal installations in September 1976, the Yosemite Park and Curry Co. decided to make the deposit system a permanent operating feature. The purpose of the deposit is to provide consumers with a monetary incentive to return empty containers for a deposit refund. This reduces the probability that containers will be discarded as litter. Beverage containers are returned to the beverage distributor if they are refillable bottles or sold as scrap if they are nonrefillable bottles or cans. The sale of returned containers as scrap helps to finance the program. It also reduces the solid waste management burden in the Park. Additionally, other environmental benefits are obtained when recycled materials are substituted for virgin materials at the production level.

The purpose of this report is to present the results or impacts of the deposit experiment over its first summer of operation.

The major impacts examined in this report are the effects of the Yosemite experimental deposit system on:

1) beverage sales and packaging mix
2) container return rates
3) recycling, solid waste, and litter
4) economics

The general findings of the experiment are summarized below and discussed in detail in the remaining sections of this report.

2. Findings

1) beverage sales and packaging mix - Two analyses of the impact of the deposit on beverage sales were conducted, one based on total sales and one on vending machine sales. Both analyses indicated that 1976 beverage sales, both retail and vended, were below the sales expected for 1976. However, it is not possible to present convincing evidence as to the cause of the sales declines since factors other than deposits (e.g. weather, number of visitors to the Park, prices) that are known to affect beverage sales are difficult to adjust for with the available data.

In mid-summer beverages in bimetal containers (7-Up and Shasta) were discontinued due to the absence of an acceptable secondary market for the returned bimetal cans. With this exception consumers apparently continued to purchase beverages in the available alternative brand/container combinations in about the same proportions as they had before the deposit system was initiated. Ninety-eight percent of carbonated beverage sales in Yosemite are in cans.

2) container return rates - Approximately 7 out of 10 beverage containers sold in Yosemite during the summer were returned.

3) recycling, solid waste, and litter - About 30 tons of beverage containers were recycled. Of this total 74 percent was aluminum; 15 percent, steel; and 11 percent, glass. Approximately 81 percent of the total recycled beverage containers had been returned for the deposit refund. Solid waste was also reduced by 30 tons. Cans marked for deposit were seldom found as litter in the Park.

4) economics - The economics of the deposit experiment were estimated by comparing revenues with costs. Revenue is available from the scrap value of the returned containers and the forfeited deposits on containers which are not returned. Costs include handling (labeling, collecting deposits, returning deposits, disposing of containers and bookkeeping), equipment and supplies, and managerial and supervisory time. Considering all costs Curry Co. estimates that the system broke even in the first summer of operation. Eliminating costs which were unique to the first summer of operation, the system would yield an expected profit of approximately $8,000 in future summers. Profit increases to approximately $12,000, if one further subtracts the Yosemite Park and Curry Co. estimate of the value of supervision and management time which they would expect to allocate once the system was in operation.

3. Yosemite National Park

Yosemite is one of 38 National Parks in the system controlled by the National Park Service (NPS). It has more overnight visitors than any other park (table 1). Yosemite is located in eastern California, about 210 miles from San Francisco and 275 miles from Los Angeles in the heart of the Sierra Nevada Range. The Park, which is 1,189 square miles in

Table 1. National Park System, 1974

	Number of areas	Annual visits (millions)	
		Total	Overnight
National Park System	309	217.4	15.4
National parks	38	53.1	NA
Major national parks		38.4	7.5
Great Smokey Mountains, North Carolina-Tennessee		9.6	0.6
Grand Teton, Wyoming		3.0	0.5
Acadia, Maine		2.9	0.2
Olympic, Washington		2.7	0.5
Rocky Mountain, Colorado		2.5	0.3
Hot Springs, Arkansas		2.4	<0.1
Shenandoah, Virginia		2.4	0.5
Yosemite, California		2.3	1.8
Yellowstone, Wyoming-Idaho-Montana		2.0	1.1
Grand Canyon, Arizona		1.9	0.6
Mammoth Cave, Kentucky		1.8	0.2
Hawaii Volcanoes, Hawaii		1.4	0.1
Glacier, Montana		1.4	0.4
Mount Ranier, Washington		1.2	0.2
Zion, Utah		1.0	0.2
National monuments	83	15.2	NA
National parkways	6	34.5	NA
National recreation areas	16	18.1	NA
National seashores	9	11.6	NA
National capital parks	1	8.7	NA
Other	156	75.9	NA
National historical, archeological, and military areas		72.9	NA
Miscellaneous other areas		3.0	NA

NA - not applicable

Source: U.S. Department of the Interior, National Park Service, 1974.

area or about the size of the State of Rhode Island, is administered by the National Park Service. Most concessions in the Park including all beverage concessions are operated for the NPS by the Yosemite Park and Curry Co. (Curry Co.), which in turn is owned by the MCA, Inc.

For the last several years the Park has received more than two million visitors annually. About 80 percent visit Yosemite during the months from May through September. This experiment ran for 126 days, from May 17 to September 19, 1976. During this time there were about 1.8 million visitors. For the month of August, which is the peak month of the year, there was an average of about 19,000 people (both visitors and employees) in the Park each day--about 12,000 staying overnight.

Between 70 and 80 percent of all visitors come to Yosemite from California and nearly 20 percent from Los Angeles County alone. Out-of-state visitors primarily come from western, mid-western and middle Atlantic states. The largest proportion of the visitors (44 percent) are between 18 and 29 years of age and the largest occupational category represented is professional and technical workers (40 percent). Over 70 percent of the visitors have attended college and nearly one-half have a college degree. Over 70 percent of those visiting Yosemite stay no more than two nights (U.S. Department of Interior, 1973).

4. The Deposit System

Yosemite has 23 retail outlets and 34 vending machines dispersed over the entire Park area. Approximately 80 percent of beverage sales are through the 19 retail outlets and 30 vending machines in the

Yosemite Valley. Soft drinks and beer are delivered directly to the large retail outlets, otherwise to a central warehouse or, in the case of beverages for vending machines, to a storage trailer.

The containers are then hand-stamped to indicate that a deposit is to be paid on the container. The stamping is done either at the retail outlet, or in the case of vending machine drinks, at a separate storage area. Deposits are collected at the point-of-sale by the cashier or incorporated as part of the sale price for vending machine drinks. Deposits are refunded upon presentation of the labeled container at any retail establishment or at the central recycling center that is located in the main shopping area of the Valley. Returned containers, other than refillable bottles, are sorted by material, bagged, transferred to a centrally located trailer in the Park, and stored. When the trailer is full it is taken to Fresno, California where the containers are sold for scrap. Refillable containers are picked up by the distributor for reuse.

5. Deposit System Impacts

The major impacts of the deposit system discussed below are: 1) beverage sales and packaging mix, 2) container return rates, 3) recycling, solid waste, and litter, and 4) economics.

5.1 Beverage Sales and Packaging Mix

The possible impacts a deposit system could have on the total sales of beer and soft drinks and on the packaging mix have become major issues. It is believed by some that a deposit system reduces beverage sales due to the increased out-of-pocket cost to consumers who do not return empty

containers for a refund or the indirect cost associated with the inconvenience of returning them.

Consumers who previously purchased beverages in nonrefillable bottles could shift either to refillable bottles (returning or discarding them) or to cans; consumers who previously purchased beverages in cans could shift to refillable bottles.

The experiment did not provide the data needed to thoroughly evaluate the sales and packaging mix in a statistically rigorous fashion.* A discussion of the possible change in beverage sales and the shift in container mix due to the Yosemite experiment follows.

5.1.1 Sales

Over the summer season 54,325 cases (at 24 containers per case) of beer and soft drinks were sold in the Park. The greatest majority of these sales was in the Valley. According to Curry Co. personnel daily beverage sales vary significantly (Figure 1) for the following reasons:

1) the daily variation in the number of people in the Park, and

2) the variation in weather (perhaps the most significant factor affecting beverage sales).

*To estimate the impact of deposits on sales and packaging mix ideally requires beverage sales and packaging data for previous periods, identification of independent variables other than the deposit (i.e. weather conditions, price, income of visitors, type of container, available brands) which may affect sales and packaging and historical estimates of these variables. Given these data one would then statistically evaluate the effect of the independent variables on sales and the packaging mix. After allowing for the effects of these variables in 1976, next examine the extent that the predicted 1976 total sales and packaging mix differed from the actual. The differences would be attributed to the deposit system.

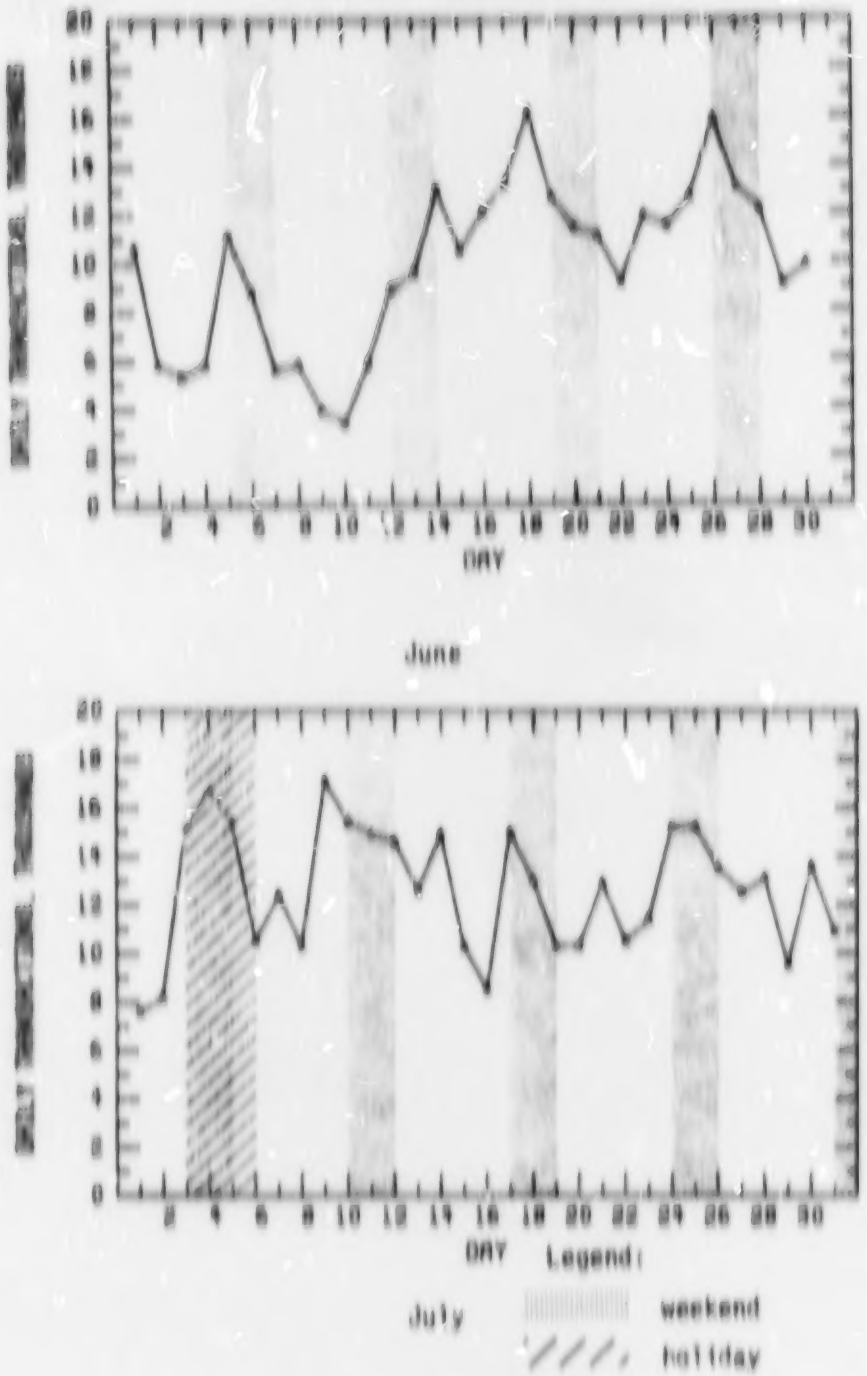
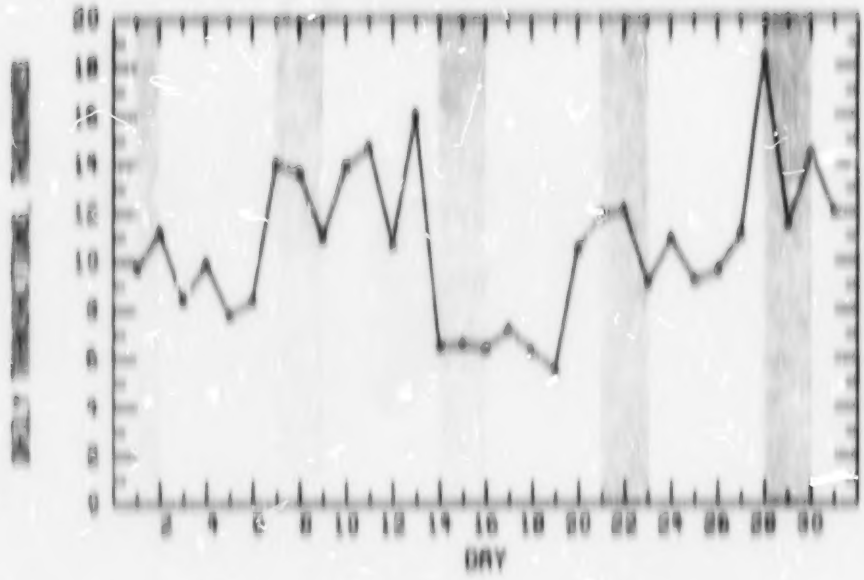


Figure 1. Daily beverage sales



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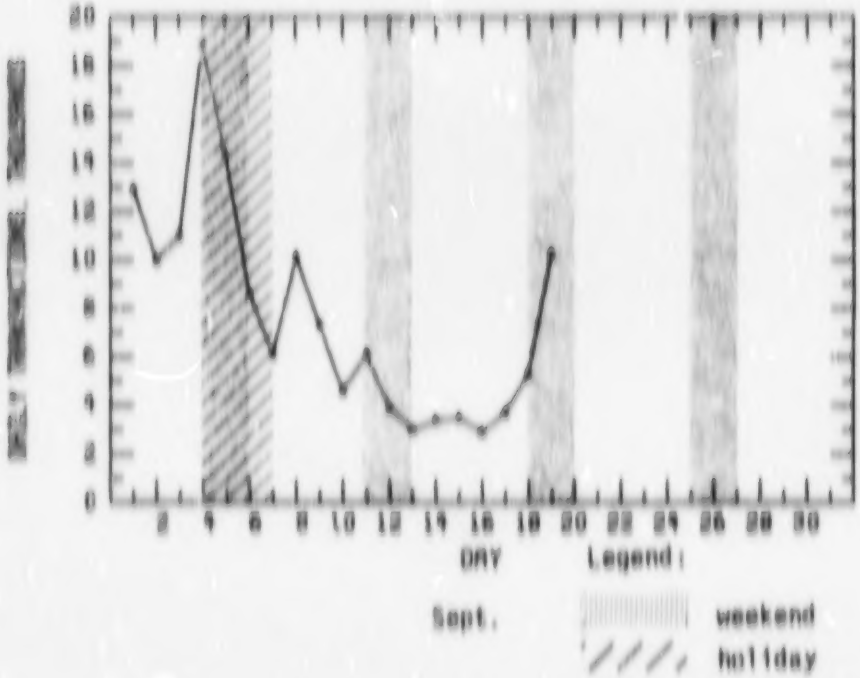

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Figure 1. Daily beverage sales (Cont.)

Thus one could hypothesize that per capita beverage sales were related to weather.* Estimates of this relationship were statistically developed.**

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*To test for the effect of price variation on beverage sales a price variation must exist. Since there was no price variation in the Park during the 1976 period this effect could not be estimated.

**The procedure was as follows. First, estimates of the number of people in the Park daily during the peak season were developed from NPS data. Daily weather data for the Park were obtained from the U.S. Department of Commerce. Finally, statistical relationships between per capita beverage sales and the weather conditions in the Park were estimated.

The NPS counts the number of vehicles entering the Park daily. Each vehicle is estimated to average 3.5 visitors. Based on the point of entry in the Park and survey estimates of the average length of stay of visitors for each point of entry, estimates of the total visitor-hours can be developed for each day of the summer. (NPS subtracts from the vehicle data NPS and other Park employee vehicles and also adjusts for bus loads of visitors. However, this has only a small effect on their estimate of visitor-hours.) Using the NPS vehicle data and the procedure outlined above the total visitor-days for the 126-day period were estimated to be 2.675 million (see appendix A). In addition, there were 1,500 to 2,200 employees of NPS and Curry Co. in the Park during the peak season. Using the 1,500 value raises the estimated total to 2.865 million person-days.

Since the only Yosemite weather data available were daily maximum and minimum temperatures for the Valley, the following daily consumption model was estimated for the 126 days using the standard statistical technique of ordinary least-squares regression:

$$\text{(1)} \qquad \ln PCS = \underset{(8.57)}{1.93} \ln TEMP - \underset{(-9.46)}{8.98}$$

$$R^2 = 0.40$$

where

PCS = per capita sales, units per person-day,
TEMP = average temperature, F°, and

the number in parenthesis below the estimated coefficients is the t-statistic.

Logarithmic coefficients provide the best quantitative approach since the coefficient on average temperature can be directly interpreted as the "elasticity" of per capita sales to the average temperature.

This estimated model attributes 40 percent ($R^2 = 0.40$) of the daily variance in per capita beverage sales to the daily variance in the average temperature. The model's explanatory power is low due to the likelihood that the procedure used to estimate visitor-days is not as accurate as it should be. Also the lack of inclusion of other possible explanatory variables besides weather has affected the results.

The results of this analysis indicate that beverage sales in the Park averaged 0.5 units daily per capita.* The hypothesized effect of weather on sales is statistically verified--every one percent increase in average temperature results in an increase of 1.0 percent in per capita sales. The convincing evidence of the effect of weather (i.e., temperature) on beverage sales emphasizes the desirability of correcting for this effect when evaluating the impact of deposits on per capita sales.

Two analyses of the sales impact of the deposit system were conducted. In the first, equation (1) above was solved for expected daily per capita sales using 1975 daily average temperatures over the same 126-day period as the deposit system was in existence in 1976. Then, using the same procedure as described above to estimate the number of people in the Park daily, expected total daily sales for 1975 were computed and summed over the 126-day period. This expected value was then compared to the estimated actual sales for the 126-day period in 1975. These results are shown below.

	Beverage sales (cases)		
	Actual	Estimated	Expected
1976			
entire year	73,053	--	--
126-day perid	64,325	--	--
1975			
entire year	81,560	--	--
126-day period	--	59,913	56,952

*An unknown quantity of beer and soft drinks is brought into the Park by visitors.

The estimated sales value (59,913) was developed by applying the 126-day share of total 1976 beverage sales to the total 1975 beverage sales value supplied by Curry Co. The results suggest that the expected 1975 sales (56,952 with deposit) for the 126 day period would have been 5 percent less than the estimated 1975 sales (59,913 without deposit) for this period. We cannot, however, be certain about what to attribute the 5 percent difference because other factors which could affect per capita sales were not controlled. Although this approach was an attempt at measuring the effect of the deposit on sales, it cannot be rigorously defended as indicating that the deposit caused a sales decline in 1976.

A second analysis was conducted using vended soft drink sales for the 1973-76 period. Vended sales are of particular interest because it is frequently speculated that deposits would significantly reduce vended sales since consumers of vended soft drinks are alleged to be especially convenience oriented. During the vended test period, vended sales represented about 13 percent of total beverage sales on a units basis.

Another consumption model was estimated using monthly vended sales data, 1973-76, as presented in Appendix B. Because the price of vended soft drinks rose from 25 to 30 cents per can beginning in August 1977 it was possible to include price variation in the model.* However, because the number of observations is small we can expect to identify only strong effects.

---

*The estimated monthly vended consumption model is:

$$(2) \quad \ln PVVS = -0.04 \ln YEAR + 0.33 \ln PRICE + 1.48 \ln TEMP - 7.17$$
$$(-0.51) \qquad (0.46) \qquad (2.97) \qquad (-3.01)$$
$$R^2 = 0.39$$

Where

PVVS = per visitor vended sales, units per visitor,
YEAR = a dummy variable, set equal to zero for years prior to 1976, set equal to one for 1976,
TEMP = average temperature, F°, and
PRICE = soft drink price, cents per unit divided by the consumer price index.

This model attributes 39 percent of the monthly variation in vended soft drink sales per visitor to the combined effects of YEAR, PRICE, and TEMP. Obviously the model is limited by the use of monthly data whereas we would have preferred to use daily data. It is interesting to note, however, that the coefficient (1.49) on average temperature for the monthly vended model is similar to the temperature coefficient (1.93) in the daily model and is statistically significant at normally accepted confidence levels (95 percent). The price of vended soft drinks has a small positive effect on vended sales.*

The sign on YEAR is negative as is expected. Letting YEAR entirely represent the effect of the deposit system, the best estimate of the true effect of the deposit system shows a reduction in vended sales per visitor of 4 percent. However with only 20 observations, 5 for 1976, the statistical quality of this estimate is poor. Specifically, 95 percent of the time, with data of the quality used in this analysis, we would expect the true value of vended sales per visitor to range between -20 percent and 0 percent (with positive values being rejected on the belief that there is no reason to expect a deposit system to increase vended sales).

5.1.2 Packaging Mix

At Yosemite over 90 percent of all the beverages are sold in cans. Cans with nondetachable closures are preferred because the detachable flip-tops are frequently littered; however, beverages are sold in cans with and without detachable tops. For many years it has been the policy,

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*This peculiar result is not alarming since the t-statistic of 0.46 indicates that the estimated positive effect is so weak that it could be obtained merely by chance.

as requested by the NPS, to minimize sales of bottled beverages because of the problems to humans and hazards to animals when bottles are littered and broken. Some soft drinks are sold in large, mostly refillable bottles. Bottled mixers, 10-ounce Schweppes products, and 12-ounce bottles of imported beer are also sold in nonrefillable bottles. In total, about 24,000 bottled beverages were sold in the Park in the 1976 summer season. There was no change in the kinds of containers sold in the Park in 1976.

A deposit system may create the potential for shifts in the packaging mix as consumers who discard the empty container would pay a higher price; that is, they would forfeit the deposit and those who return the container would incur some inconvenience. The result would be reflected in changes in the rate of beverage sales by container type--some beverage-container combinations being purchased more frequently and others less frequently than prior to the institution of the deposit system.* This behavior would result in shortages for some beverage-container combinations and surpluses for others. Retailers would presumably order more of the products in short supply and less of those for which surplus supplies existed experimenting until they again found the new optimum order rate for each beverage-container combination.

As noted above, Curry Co. is the prime concessionaire at Yosemite. It offers for sale and sells primarily beverages in cans with prices being set

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*The effect of brand loyalty and consumer choice is important to emphasize here. If the brand is offered in alternative containers then consumers have the opportunity of switching containers without switching brands. On the other hand if brands tend to be offered in only one container type then the consumer must switch brands to switch containers. Further, even though beverage distributors may offer their product in alternative containers, retailers may not elect to stock all types.

by the NPS. No change in the brand-container combinations offered for sale was made by Curry Co. with one important exception discussed below. The NPS policy of minimizing bottled beverage sales was not changed after instituting the deposit system.

In the absence of a competitive market with a broad choice of brands and containers it is difficult to generalize regarding the impact of the deposit system on package mix. However, in Yosemite no shortages occurred in the refillables offered for sale nor were there any requests by visitors for brands or sizes of beer and soft drinks in refillable bottles other than those carried. Therefore, at least in this setting, no significant changes in packaging mix were either possible or requested by visitors.

The exception noted above was the bimetal can. The closest market for returned bimetal cans is South San Francisco whereas aluminum cans could be sold to a scrap dealer in Fresno. Therefore, for all but a couple of specialty beverages, those in bimetal cans were discontinued about mid-summer. The primary brands affected were 7-Up and Shasta.

5.2 Container Return Rates

For the 126-day test Curry Co. personnel tabulated daily deposits paid and returned for each of 23 retail and 34 vending locations. These data, which are summarized in appendix A are the basis of the conclusions drawn here.

Over the entire 126-day period 1,303,800 bottles and cans of beer and soft drinks were sold in the Park. Deposits were refunded on 903,800 containers; therefore, the return rate for the summer averaged 0.69 or said another way, almost seven out of every ten beverage containers sold were returned. According to Curry Co. personnel operating the recycling center,

probably a small share of the total returns are by scavengers who collect littered containers or who obtain them from trash receptacles, dumpsters, transfer stations and the landfill.

Daily beverage sales and returns are shown in figure 2, and simple daily return rates (developed by dividing returns for the day by sales for the day) in figure 3. The lagged structure of container returns, and the effect of the day-of-week and day-of-summer on return rates were investigated.

Briefly summarized, it was estimated that about 39 percent of containers sold are returned on the day of sale, 15 percent one day after, 6 percent two days after, 4 percent three days after and the remaining 5 percent more than three days after the date of sale.*

The day of the week analysis was confounded by the presence of an anomaly in the reporting of the data.** Therefore, while only tentative conclusions can be drawn, it does appear that Saturday return rates are somewhat lower than average and Sunday somewhat higher. This would appear to be confirmed by Curry Co. personnel at the recycling center who report that Sundays are especially busy since for many visitors it is the day they

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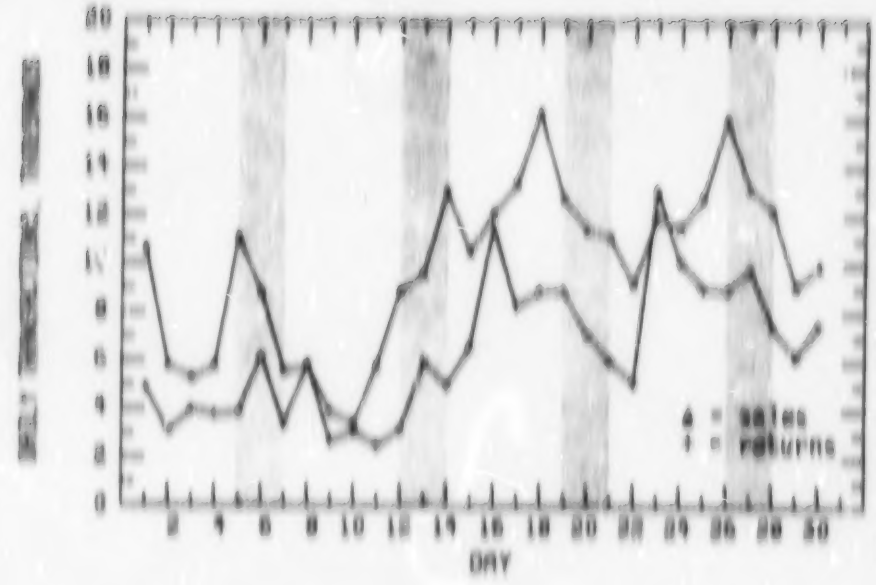
*To develop estimates of the time-distribution of container returns the following model was estimated using ordinary least squares regression.

$$(3) \qquad R_t = S_t + a_1 S_{t-1} + a_2 S_{t-2} + \ldots + a_n S_{t-n}$$

where R = returns of containers on day t, and
S = sales of beverages on day t.

The R^2 statistic for the model is 0.58. The coefficients (a_1, a_2, ... a_n) preceding the sales terms can be directly interpreted as the share of sales for that time (i.e., day) that were returned in day t.

**Specifically, for several Thursdays vended sales were reported as zero.



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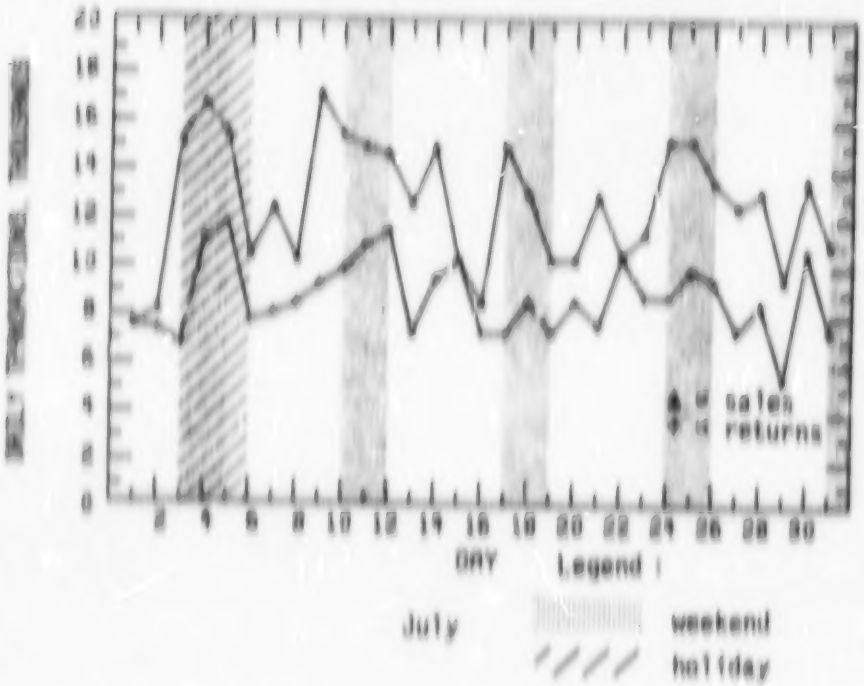

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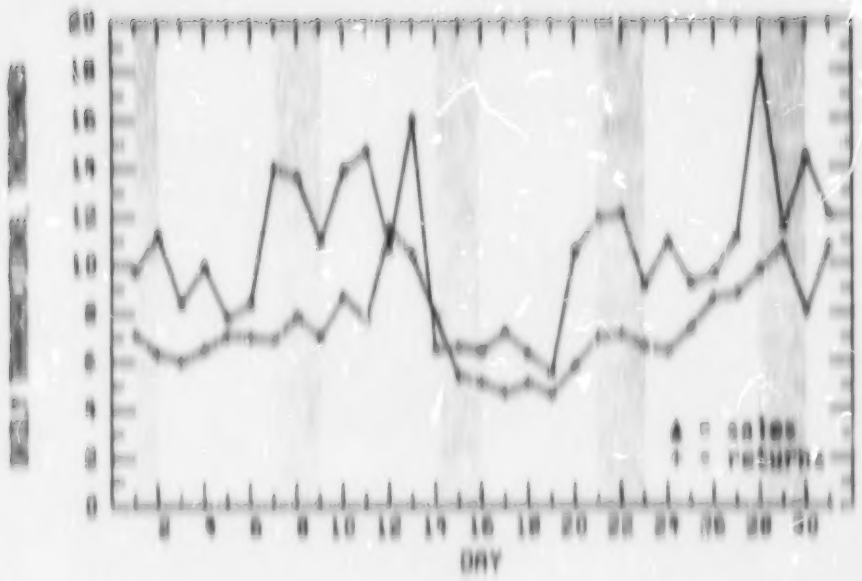
Figure 7. Daily beverage sales and returns



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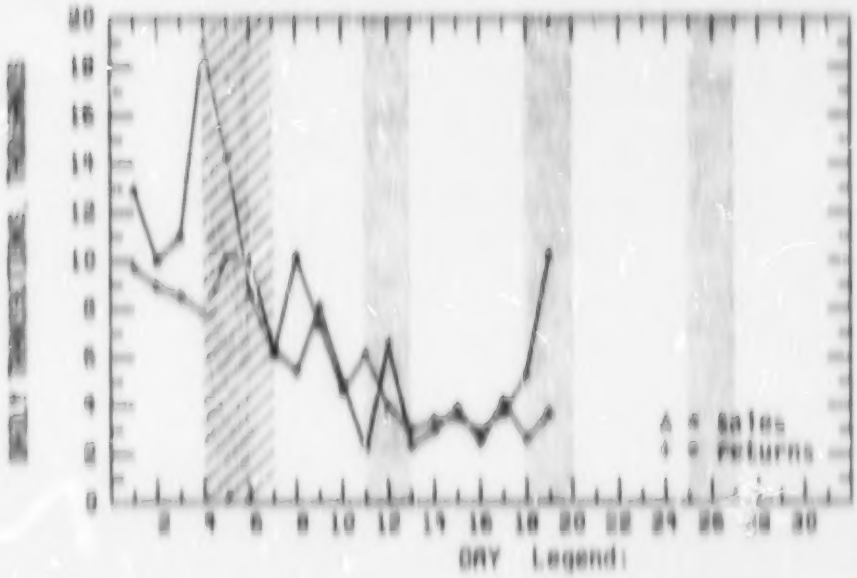

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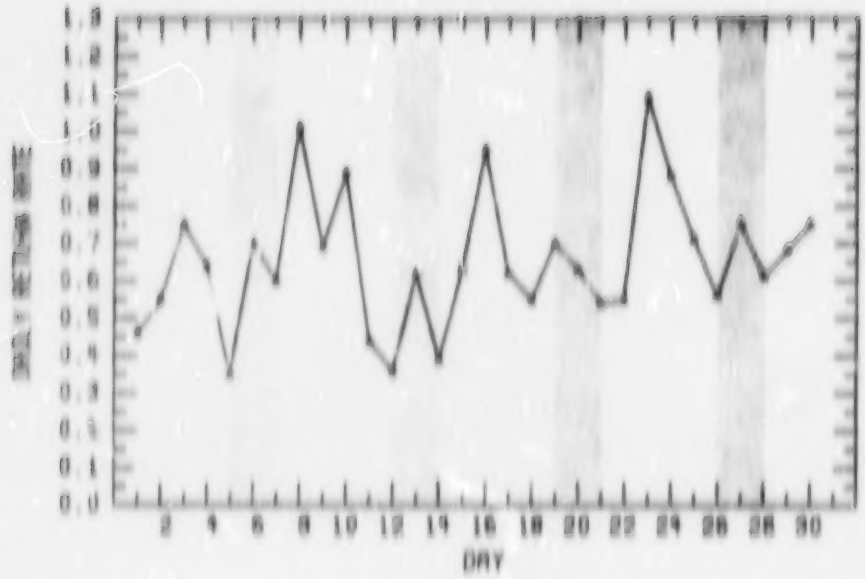
Figure F. Daily beverage sales and returns (Cont.)



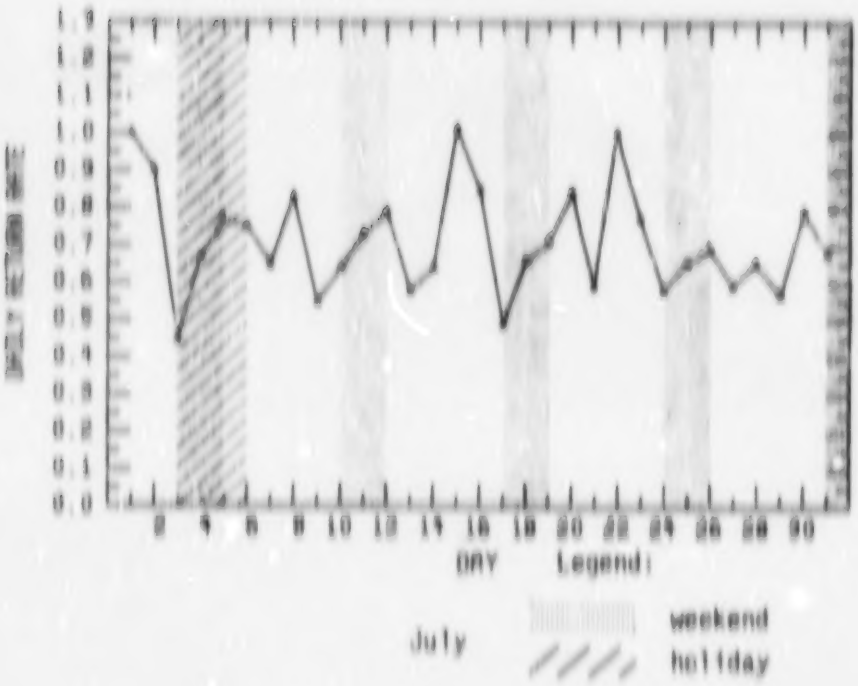
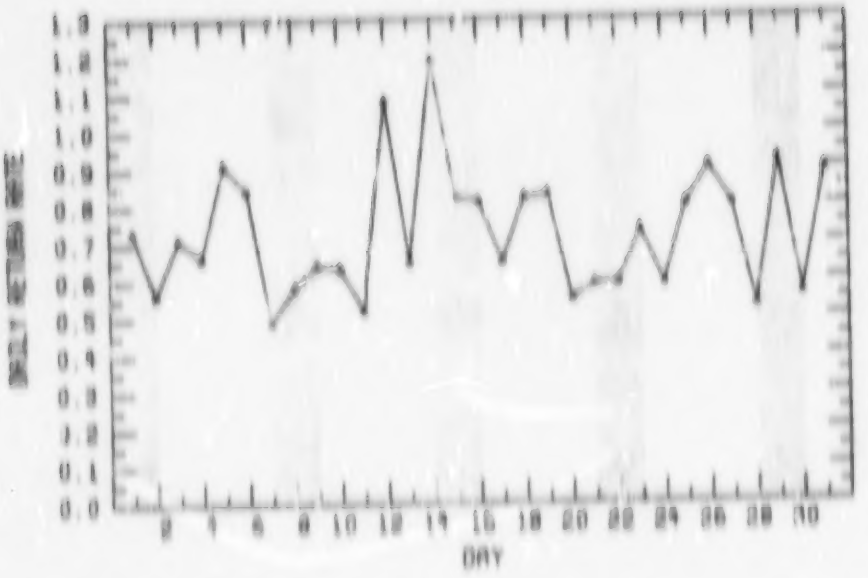
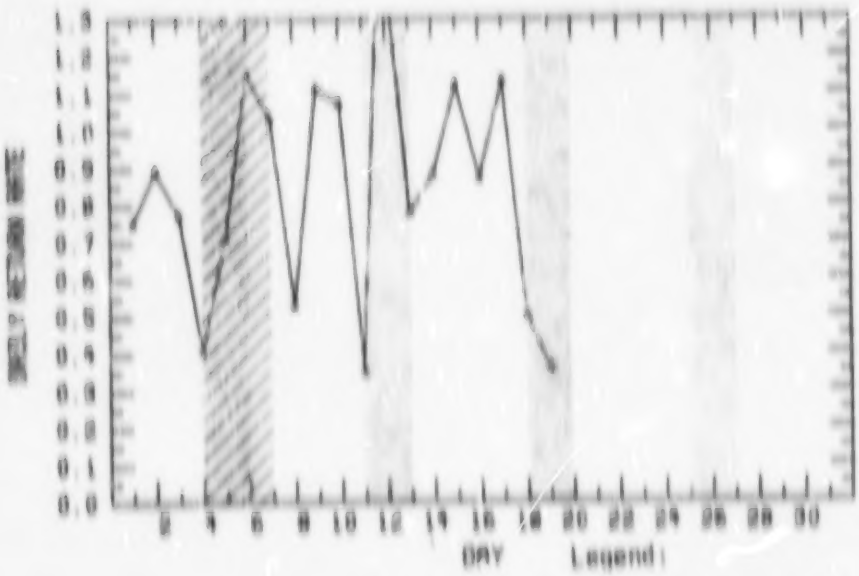


Figure 3. Daily return rate



Aug.



Sept.

Figure 3. Daily return rate (Cont.)

leave the Park. A test for a day-of-the summer effect indicated no significant trend over the summer in return rates.

5.2.1 Vended Sales

At the request of EPA Curry Co. personnel ran a special test on vended sales to determine whether return rates from vended soft drinks varied significantly from those for nonvended beverages. Curry Co. personnel marked all vended cans with a different color stamp during a one-week period, July 19 to July 25. At the end of each day, 20 cans were sampled from each bag of returned cans. There are approximately 400 cans per bag. This sampling was continued one week beyond the last day of the special marking of vended containers.

The expected proportions of container returns which should be represented by vended sales, based on the proportion of vended to total sales, were compared to the actual proportions found in the sample. Based on the application of standard statistical techniques, it was concluded that there is no strong evidence that the return rate of vended containers differs from the return rate of 69 percent for all containers.*

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*The expected proportions were estimated from the time distribution of container returns and the vended sales data. They were compared to the actual proportions found in the sample and a chi-square test was used to test for a significant difference.

This test statistic is computed as :

$$\sum_{i=1}^{n} \frac{(\text{observed } i - \text{expected } i)^2}{\text{expected}}$$

where "observed" is the proportion of specially marked cans found in the sample of returned cans taken each day, and "expected" is the proportion of cans we could expect to find in the sample if the null hypothesis is true. "Expected" was computed as a distributed lag of past sales divided by returns for the day, where the lag weights were those estimated for beverage returns as a whole. The statistic is distributed as chi-square with n-1 degrees of freedom.

5.3 Recycling, Solid Waste, and Litter

In 1975 Curry Co. established a recycling program "...to reduce the waste of material resources and energy, and to reduce to a minimum the need for garbage to be hauled to a land-fill" (Yosemite Park and Curry Company, 1975, p. 2). A centrally located Recycling Center is maintained adjacent to the Village Store and is open daily during the peak season. Additional centers are in employee housing areas. In 1976, 95 tons of waste materials were recycled including almost one ton of aluminum, one ton of steel (bi-metal), two tons of tin, 11 tons of glass and 80 tons of cardboard (Yosemite Park and Curry Company, 1976, p. 3). Other recycled materials include: newspapers, copper, batteries, and tires. As a result of these efforts, prior to the institution of the deposit system, Curry Co. had already identified markets for the materials present in returned containers and had developed systems for handling returned materials.

During the 126-day test period, Curry Co. recycled about 30 tons of glass, bimetal, and aluminum beverage containers. As shown in table 2, the predominate material recycled was aluminum. Of the 30 tons, at least 83 percent represents containers which were returned for the 5-cent refund. The deposit system apparently induced "piggy backing" as consumers also returned containers not purchased in the Park. The returned containers were bagged and shipped to Fresno where they were sold for scrap.

Obviously, the recycling of returned containers not only produces revenue to help finance the deposit system but also reduces the quantity of solid waste which otherwise must be collected, transported out of the Park and properly disposed of in a landfill.

Table 2. Recycled beverage containers, summer 1976

Material	Pounds		
	With deposits	Without deposits	Total
Glass	NA	NA	6,661
Bimetal	7,141	1,548	8,689
Aluminum	41,943	2,173	44,116 1/
Total			59,466

NA = not available

1/ Of this total collected, 37,025 pounds were allowed by the recycling company.

Source: Yosemite Park and Curry Co.

Prior to the institution of the deposit system there were no surveys of litter in Yosemite which could serve as a benchmark for estimating the impact of the deposit system on container littering. However, NPS personnel responsible for collecting litter believe that fewer littered containers were collected in the summer of 1976 than in previous years. Reportedly, refund bearing containers were seldom found.

5.4 Economics

The cost of the deposit system to a Park concessionaire is estimated by subtracting the cost of labeling, handling, bookkeeping and other relevant costs (including the time and cost of designing the system, designing and printing consumer information material, running special tabulations, and meeting with and answering questions from EPA, RTI, the press and other interested parties) from the forfeited deposits on containers not returned and the scrap value received when returned containers are recycled. Of

special mention is the treatment of solid waste costs. If recycled containers result in a reduction in solid waste cost then a credit for these cost savings should also be included.

Based on a simple model of the costs of a deposit system, presented below and more fully discussed in A Guide to Implementing a Deposit-System (Youngblood and Bingham, 1977), estimates of the cost of the system at Yosemite were calculated. In developing the cost estimates presented here the approach was to first present those costs of the deposit system which primarily relate to beverage sales or container returns. Then various other costs were included which tend to be related to the existence of the deposit system rather than to the volume of beverage sales or container returns. To the extent possible the results were generalized so that the reader may visualize the economics of a deposit system in other situations.

Although the values were, of course, developed from the Yosemite experiment, what is presented should not be interpreted as representing a rigorous analysis of the Curry Co. costs.

5.4.1 Handling Costs

The total handling costs of a deposit system include the extra expenditures to:

1) label the container,
2) collect the deposit,
3) return the deposit,
4) dispose of the containers, and
5) keep records of costs and revenues.

These five categories of expenditures in addition to the associated labor costs are discussed below and summarized in table 3.

Table 3. Container handling costs by activity

Activity	Productivity (manhours per 100 cases)	Labor cost (dollars per manhour)[5]	Activity cost (dollars per 100 cases)
(1) Label	1.00[1]	$ 3.89	$ 3.89
(2) Collect deposit	0.23[2]	3.89	0.89
(3) Return deposit	1.86[2]	3.89	7.24
(4) Dispose of containers	4.87[3]	3.34	16.46[6]
(5) Accounting	0.12[4]	4.23	0.51

1/ Based on Yosemite experience with hand-stamping of 100 cases per manhour.

2/ From Alpha Beta Acme Markets, Inc.

3/ From Alpha Beta Acme Markets, Inc. for the following activities: 1) moving full rack of bottles to storage area, 2) clearing of bottle storage area, 3) sorting of bottles from rack, 4) moving empty rack to front, and 5) checking empties to driver.

4/ Based on Yosemite experience of 30 minutes daily.

5/ Based on Yosemite wages plus 36.5 percent fringe benefit factor.

6/ Includes a mileage charge on the truck used for daily pickups of $0.19 per 100 cases.

1) label - All containers at the Park were stamped by hand with a soft sponge stamp. The cost of 24 stamps and 12 pints of frozen food ink, which was chosen because it can withstand moisture, was $267. The containers were stamped on the bottom at an estimated rate of 100 cases per manhour.

2) collect deposits - The sales clerk must expend additional time with each beverage customer to ring up and collect the deposit. No estimate of these costs is available for the Yosemite experiment; however, a time and motion study indicates about 0.1 seconds are required per container to ring up the deposit. This value has been used here. On a total basis, this would imply the equivalent of one additional employee at Yosemite over the 126-day test period. Obviously, however, the total time required to collect the deposit is distributed over all retail clerks and is not likely to result in an employment increase.

3) return deposits - For all returned containers, the cashier must ring up the deposit being returned and return the deposit to the customer. No estimates of the time or cost of this activity have been developed by Curry Co. However, based on the time and motion study, the time required can be as high as 2.8 seconds per container. This value would imply the equivalent of an additional 0.7 employees for the 126-day period.

4) dispose of containers - The returned containers are bagged, stored and, when a truck load is accumulated, shipped to Fresno where they are sold for scrap.

At Yosemite the recycling center is manned from 9 a.m.-8 p.m. seven days a week during the peak season. About four additional manhours are required daily to collect returned containers from the retail outlets and to

truck the recycled materials to a central storage area prior to being shipped to Fresno for a total of 15 manhours daily. Estimates of the time spent at the retail outlets are not available. Assigning the total of 15 manhours daily to the deposit system results in a productivity rate (manhours per returned container) quite similar to the estimate developed from a supermarket time and motion study.

5) accounting - The additional bookkeeping requirement is informally estimated by Curry Co. to be 30 minutes daily or about 0.2 seconds per container on average for the summer season. This value is about equal that of the highest value reported in the time and motion study.

6) labor costs - The cost of performing the above tasks is the product of the productivity of the employee (manhours per container) and the cost of the employee (dollars per manhour). These costs include not only the wages paid the employee but also taxes and fringe benefits which include lodging and meals. Curry Co. estimates these costs to average 36.5 percent of the wage base. The recycling staff is paid $2.45 per hour, sales clerks $2.05 and bookkeepers $3.10. The resulting costs per 100 cases are shown in the fourth column of table 3.

5.4.2 Revenue

The primary revenues which accrue to retailers under this deposit system are: 1) forfeited deposits, and 2) sales of the returned containers for recycling. Because the MPS charges Curry Co. per load of collected solid waste and because frequency of collection has not been altered, no solid waste costs were avoided.

The scrap prices paid to the Curry Co. are shown in table 4. Since no transportation costs were incurred by Curry Co. the FOB and delivered scrap value are the same.

5.4.3 Gross Profits

The average profits per container due to the deposit are

(4) $$P = R - C$$

where

P = profits per unit of beverage sold,

R = revenues per unit of beverage sold, and

C = cost per unit of beverage sold.

The costs can be divided into those costs incurred on every sale plus those incurred when a container is returned or:

(5) $$C = (LABEL) + (COLL) + (ACC) + RR[(DISP) + (RET)]$$

where

LABEL = cost of labeling,

COLL = cost of collecting deposit,

RET = cost of returning deposit,

ACC = cost of bookkeeping,

RR = fraction of containers returned, and

DISP = cost of disposing the returned container.

The revenues can be divided into the forfeited deposits and the scrap sales of returned containers:

(6) $$R = (1-RR)(D) + (RR)(SV)$$

where

D = deposit, and

SV = scrap value of the container.

Table 4. Container scrap values

Container	Weight (lb per 100 cases)	Scrap value (dollars per ton)	Scrap value (dollars per 100 cases)	Net scrap value (dollars per 100 cases)
Aluminum can	105.6	$ 300	$ 15.84	$ 15.74 1/
Steel can (bimetal)	264.0	20	2.64	* 2/
Nonrefillable bottle				
beer (12 oz)	919.2	20	9.19	6.02 1/
soft drink (16 oz)	1500.0	20	15.00	11.83 1/

1/ Calculated from transportation cost data provided by Curry Co.

2/ Not computed since nearest market is San Francisco, an uneconomical distance to ship scrap steel from Yosemite.

The gross profits thus depend on the return rate and the scrap value of the container returned. It is necessary to examine each container because each has a unique salvage value.

The resulting gross profit rates (dollars per 100 cases) for beverages marketed in aluminum cans and glass bottles are:

aluminum can = 114.71 - RR(127.96),

nonrefillable beer bottle (12 oz) = 114.71 - RR(137.68), and

nonrefillable soft drink bottle (16 oz) = 114.71 - RR(131.67).

The above gross profits for the three container types at the Yosemite return rate of 59 percent as well as a set of alternative return rates are depicted in table 5. This table clearly shows the inverse relationship between the return rate and gross profits--as the return rate goes up, profit decreases. However, it should be pointed out that a major cost element is labeling. At Yosemite this was done by hand at an estimated cost of $3.89 per 100 cases (table 3) or approximately $2,000 for 54,000 cases. If containers can be

[illegible]

labeled by the beverage producer, labeling cost could probably be significantly reduced. The total handling costs and revenues by activity are shown in table 6.

5.4.4 Net Profits

The above estimated profit rates are based on the inclusion of the major handling costs only. In addition, Curry Co. indicates the existence of other costs for both equipment and supplies as well as supervisory and management time. Some of these costs can be accurately identified, however, most must be estimated. Table 7 summarizes the economics of the deposit experiment using both the actual return rate (0.69) and alternative return rates.

Based on total beverage sales of 54,325 cases and the assumption that 98 percent of sales were in aluminum cans with the remainder equally divided between nonrefillable beer and soft drink bottles, a gross profit of $14,304 was made during the first summer.* However, Curry Co. has estimated that about $6,298 was required for equipment and supplies as well as for supervision and management of the deposit experiment. The labor time ($4,101) is an estimate of the cost of the time spent by Curry Co. supervisory and management personnel. This time was supplied by the regular Curry Co. employees, so no actual out-of-pocket expenses were incurred. However, since they were devoting time to overseeing the experiment, some other activities were getting less attention than they otherwise would. The result of subtracting these costs results in an expected profit of $8,006 for future summers--assuming the costs, productivity, return rates, and sales volume are the same.

*This value differs slightly from the value shown in table 6 ($14,160) primarily due to rounding errors.

Table 6. Total handling costs and revenues by activity

Activity	
Handling costs	
Label	2,113
Collect deposit	483
Return deposit	2,714
Dispose of containers	6,170
Accounting	277
Subtotal	$ 11,757
Revenues	
Forfeited deposits	30,709
Scrap sales	
Aluminum cans	5,554
Steel cans (bimetal)	87
Nonrefillable beer bottle	97
Subtotal	$ 25,917
Gross profits	$ 14,160

[redacted]

[redacted]

[redacted]

In addition, management time was also expended due to start-up and the experimental nature of the system. Subtraction of the estimated value of this time ($6,525) leaves a net profit of $1,481. There were a few other costs which are not included here for phone calls, trips to EPA in San Francisco by Curry Co. personnel to discuss the program implementation and the cost of a shipment of bimetal scrap. If all these additional items are also included, the deposit system for the first summer would break even.

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APPENDIX A: DAILY SALES AND RETURNS

Table A-1. Daily sales and returns, 1976

Reproduced from best available copy.

Month	Day	Average temperature (degrees Fahrenheit)	Total visitor days*	Sales (units)	Returns (units)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

A-9

Table A-1. Daily sales and returns, 1976 (Cont.)

Month	Day	Average temperature (degrees Fahrenheit)	Total visitor days*	Sales (units)	Returns (units)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7.	1.	65.5	1454.4	[illegible]	[illegible]
7.	2.	63.5	2905.9	4252.	1459.00
7.	3.	63.5	2715.2	[illegible]	[illegible]
7.	4.	[illegible]	2291.3	[illegible]	[illegible]
7.	5.	[illegible]	2544.7	[illegible]	[illegible]
7.	6.	71.	2147.5	[illegible]	[illegible]
7.	7.	74.	2345.4	[illegible]	[illegible]
7.	8.	[illegible]	2244.9	[illegible]	[illegible]
7.	9.	73.5000	[illegible]	[illegible]	[illegible]
7.	10.	72.5000	[illegible]	[illegible]	[illegible]
7.	11.	[illegible]	[illegible]	[illegible]	[illegible]
7.	12.	[illegible]	[illegible]	[illegible]	[illegible]
7.	13.	[illegible]	[illegible]	[illegible]	[illegible]
7.	14.	[illegible]	[illegible]	[illegible]	[illegible]
7.	15.	[illegible]	[illegible]	[illegible]	[illegible]
7.	16.	77.5000	[illegible]	[illegible]	[illegible]
7.	17.	[illegible]	[illegible]	[illegible]	[illegible]
7.	18.	[illegible]	[illegible]	[illegible]	[illegible]
7.	19.	72.5000	[illegible]	[illegible]	[illegible]
7.	20.	[illegible]	[illegible]	[illegible]	[illegible]
7.	21.	[illegible]	[illegible]	[illegible]	[illegible]
7.	22.	[illegible]	[illegible]	[illegible]	[illegible]
7.	23.	[illegible]	[illegible]	[illegible]	[illegible]
7.	24.	[illegible]	[illegible]	[illegible]	[illegible]
7.	25.	[illegible]	[illegible]	[illegible]	[illegible]
7.	26.	[illegible]	[illegible]	[illegible]	[illegible]
7.	27.	86.5000	2238[illegible]	[illegible]	[illegible]

Table A-1. Daily sales and returns, 1976 (Cont.)

Reproduced from best available copy.

Month	Day	Average temperature (degrees Fahrenheit)	Total visitor days*	Sales (units)	Returns (units)
[illegible]					

Table A-1. Daily sales and returns, 1976 (Cont.)

Month	Day	Average temperature (degrees Fahrenheit)	Total visitor days*	Sales (units)	Returns (units)
[illegible]					

*Estimated from the number of vehicles entering the Park based on 3.5 visitors per vehicle and the following average hours per visitor by portal of entry:

Circle Park	48.3
South Entrance	48.3
Big Bar Flat	35.3
Triage Pass	27.1

485 seat Carry employees of 1500 are added to visitor-day total obtained above to get people-days.

APPENDIX B: MONTHLY VENDED SALES

Table 9-7. Monthly vendor sales

Month	Year	Visits	Vendor sales (units)	Mean temperature (degrees Fahrenheit)
January	1975	27,110	25,700	60.7
February	1975	30,935	40,320	66.0
March	1975	45,104	62,700	70.3
April	1975	51,091	51,400	71.5
May	1975	25,102	25,900	64.7
June	1974	23,425	24,050	59.7
July	1974	34,382	45,070	66.2
August	1974	41,183	44,900	70.3
September	1974	47,892	60,700	71.9
October	1974	30,377	44,700	70.3
November	1975	25,953	22,500	59.5
December	1975	45,278	54,100	65.2
January	1975	51,045	62,500	69.0
February	1975	54,462	60,000	67.0
March	1975	30,927	41,400	67.4
April	1976	18,129	24,200	62.4
May	1976	37,112	45,500	65.5
June	1976	43,273	55,000	73.7
July	1976	48,319	61,400	66.2
August	1976	49,510	52,400	65.4